Linguistic Social Robot Control by Crowd-Computing Feedback

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2. Social robots, crowd-computing (2 slides).
3. A preliminary case study (12 slides).

1. Cyber-Physical Systems (dfn)

- CPSs (Cyber-Physical Systems) are technical devices with certain adaptive, sensing and reasoning abilities.

Ongoing initiatives regarding CPSs:

- Industrie 4.0 initiative (Germany).
- The Industrial Internet initiative (USA).
- The Society 5.0 initiative (Japan).

- The CPSs in our interest are Social Robots in children (special) education applications.
  Our interest is not in “learning about robotics”, but rather it is in “robotics assisted learning”.

2. Social robots

Crowd-computing (dfn)

- “harnessing the power of people out in the Web to do tasks that are hard for individual users or computers to do alone. Like cloud computing, *crowd computing* offers elastic, on-demand human resources that can drive new applications and new ways of thinking about technology.”

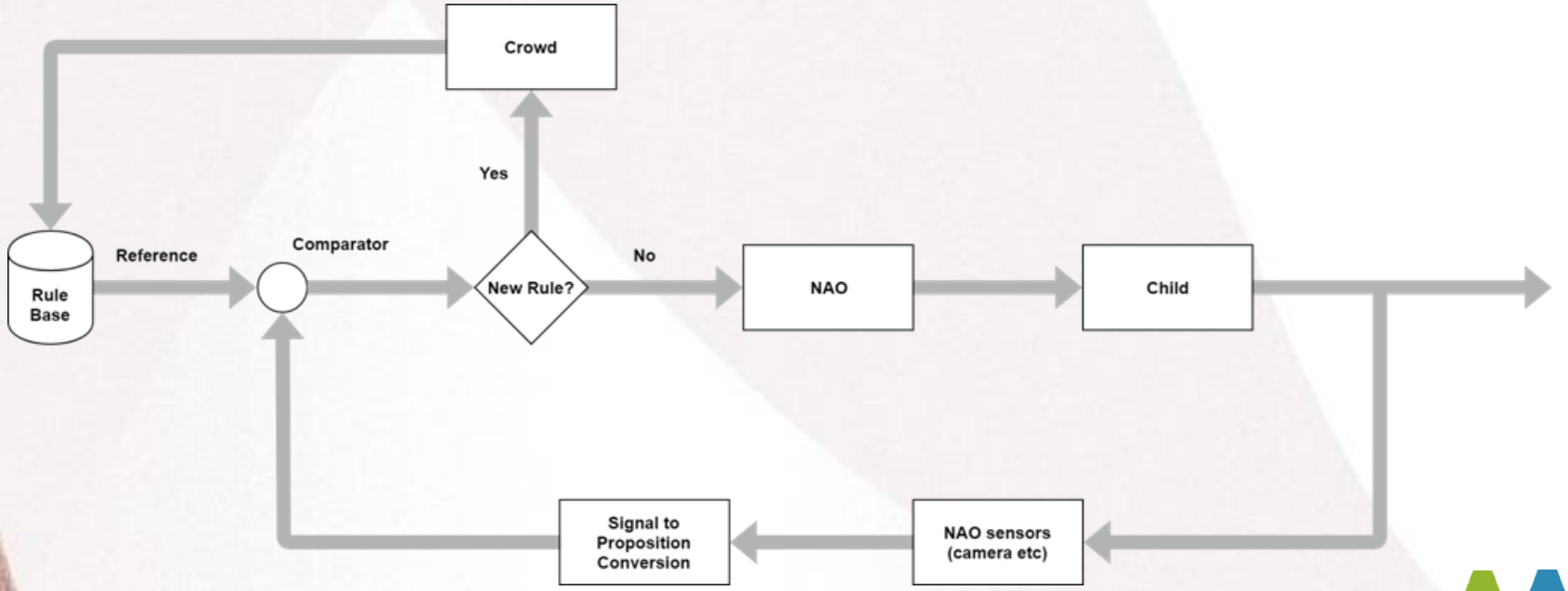
3. A preliminary case study

- While social robots become ever more popular, novel modeling and control methodologies are sought toward optimizing their engagement.

- A novel feedback control, namely “AB-scheme”, is proposed using a resultant sentence, induced by crowd-computing techniques, as Reference to be compared with a computer-vision induced sentence toward driving a linguistic controller.

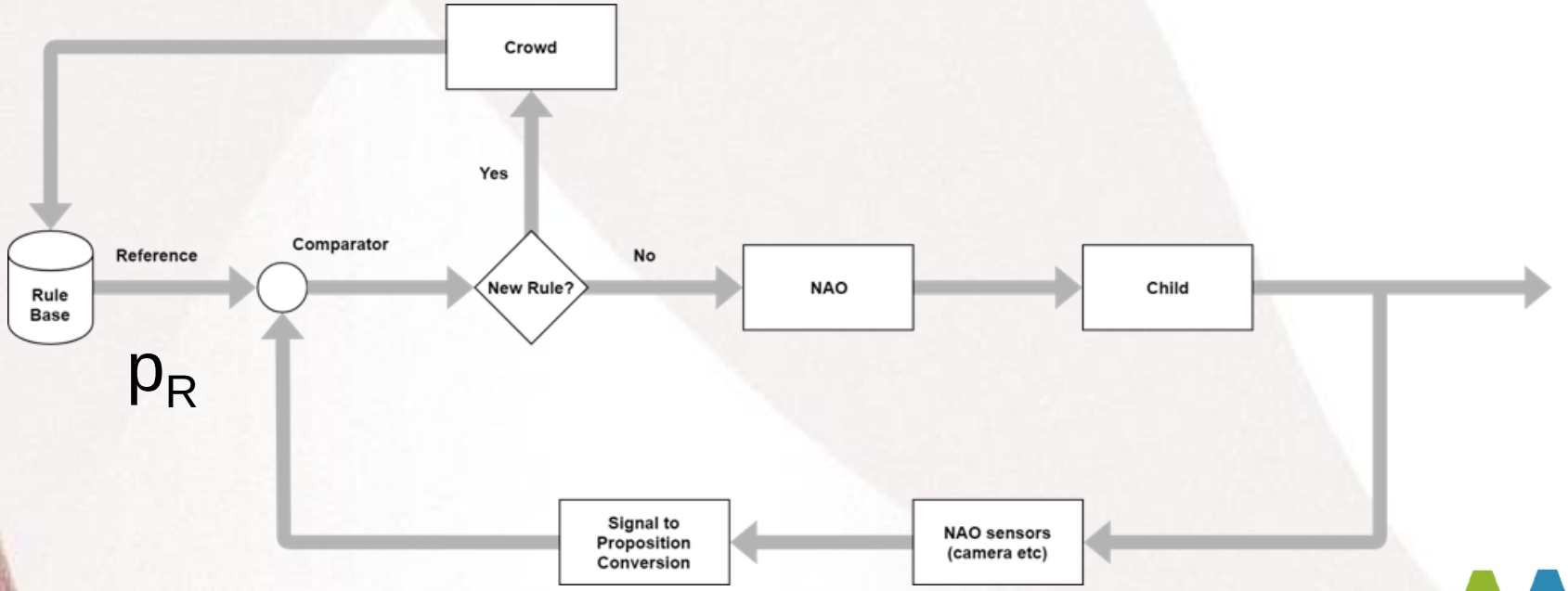
The AB-scheme

a. A Rule Base includes deterministic knowledge elicited from experts and represented by (fuzzy) rules.



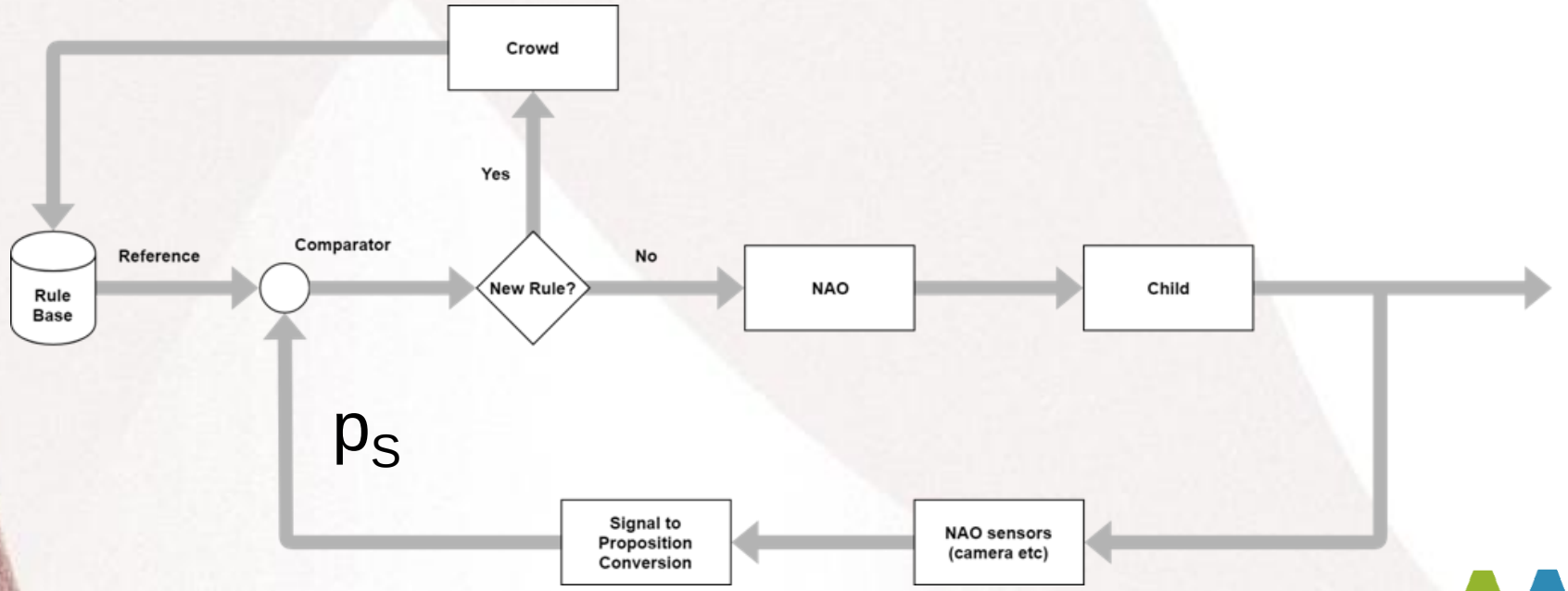
The AB-scheme

b. The Rule Base calculates a Reference proposition p_R as an input to a Comparator.



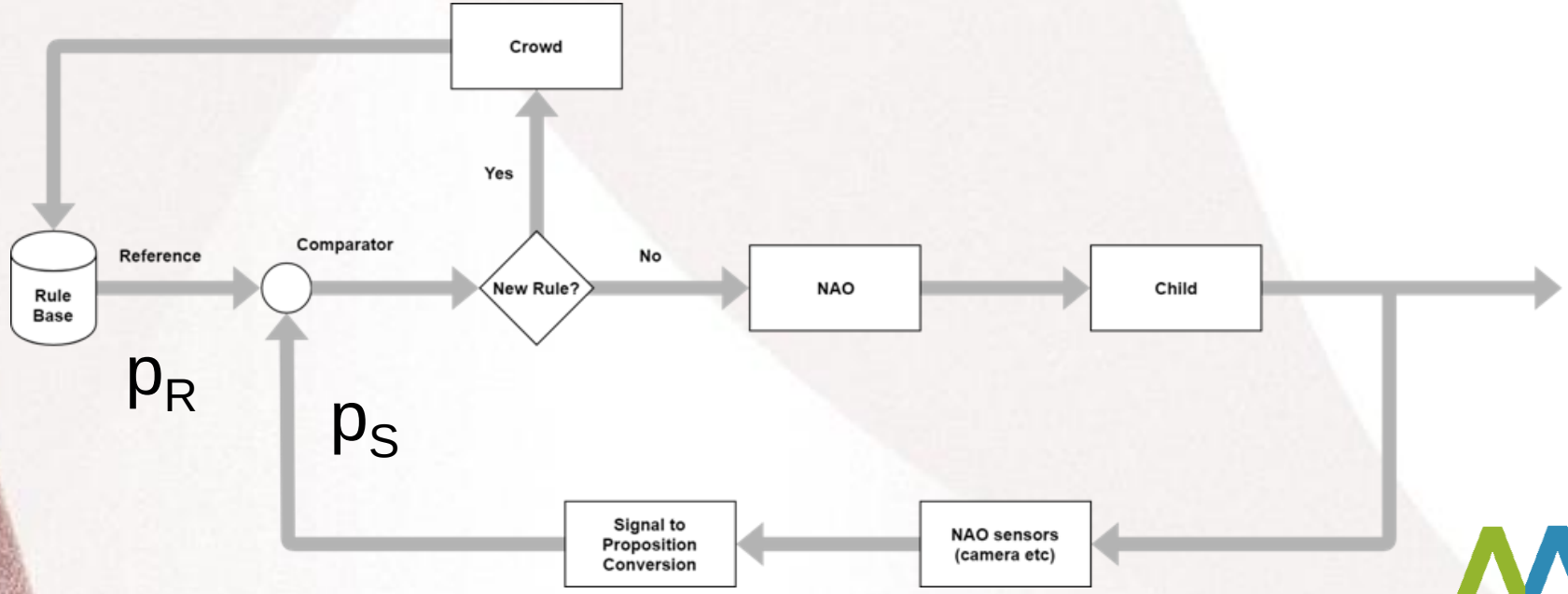
The AB-scheme

c. NAO sensor signals are processed toward inducing a proposition p_S.

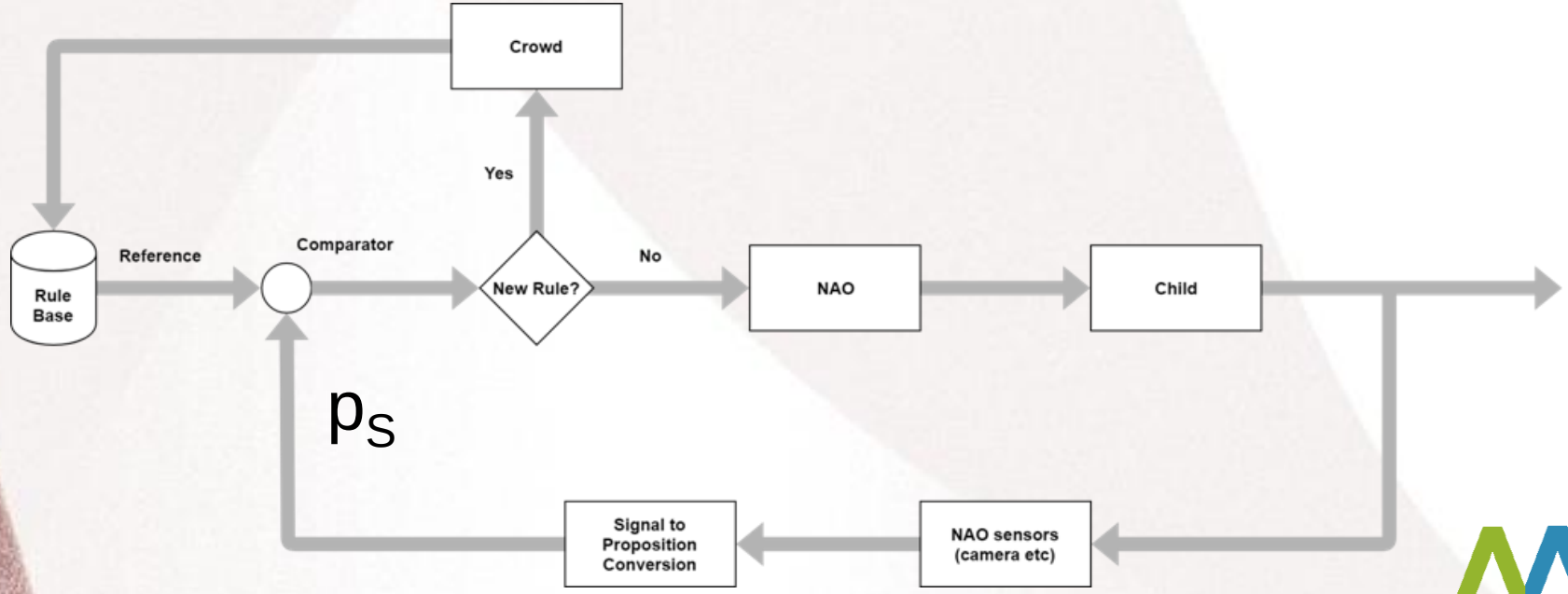


The AB-scheme

d. The propositions p_R and p_S are compared toward driving a Linguistic Controller (in the NAO robot) toward bringing the Child to the desired Reference.



The induction of proposition p_S from sensory data was necessary toward eliciting the verbal advice of experts via a Social (Internet-based) Network.



A-B Scheme “Principles”

- If the sentence induced by computer vision appears for the first time then it is sent to the Crowd.
  - The Crowd suggests an action to be implemented by NAO.
  - This process continues until the child’s expression is “Happy”.
  - The rule is stored in the Rule Base for future use.
- If the sentence has appeared previously then the corresponding rule is used.

A-B Scheme Application

Visual Pattern Recognition

- Gender (2) - Face Recognizer.
- Age (14 age groups) - Convolutional Neural Network (CNN).
- Game (3 different) - Cascade Classifier.
- Expression (5 different) - Face Recognizer.

3*14*5*2 = 420 combinations are possible

Sentence Example:

“A boy 5 years old is playing with a board-game, and he is smiling.”

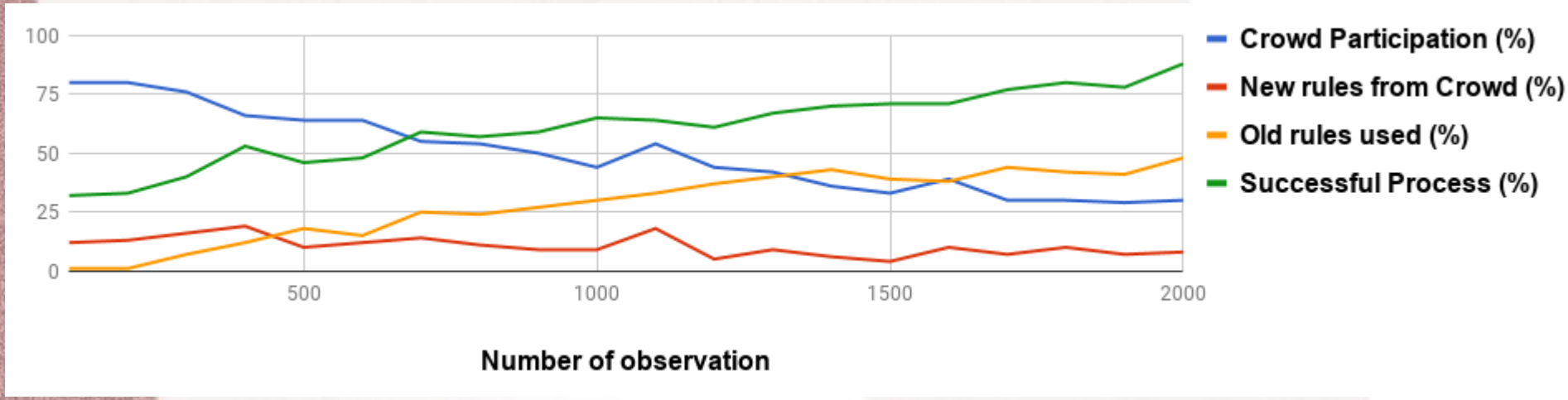
A-B Scheme Application

Training Data Information

Feature	**Dataset (number of images)**	**Image dimensions (px)**	**Training time (hours)**
Age	0	0	0
Expression	400	various	4
Gender	>41.000	100X100	72
Game	>45.000	50X50	1260

Preliminary Application Results

After 2000 times, the success percentage (Happy Child) reaches 88%.



Conclusions

- The software/hardware infrastructure, necessary for elaborate experiments in the future, is developed.
- Preliminary application results, demonstrated here, have been encouraging.
- Our proposed techniques are expected to enable the engagement of lower skilled personnel for delivering (much) higher skilled instruction in University Teaching /Instruction and beyond.

Thank You

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